

(iii) After the engine reaches the speed required in paragraph (a)(2)(ii) of this section the throttle shall be moved rapidly to, and held in, the fully closed position. Immediately after the throttle is closed, the preselected load required to perform the acceleration in paragraph (a)(2)(iv) of this section shall be applied. For electric motoring dynamometer operation in speed mode, the deceleration shall be performed in  $2\pm1.5$  seconds.

(iv) When the engine decelerates to the intermediate speed (within 50 rpm), the throttle shall be moved rapidly to, and held in, the fully open position. The preselected dynamometer load which was applied during the preceding transition period shall be used to control the acceleration of the engine so that the speed increases to at least 95 percent of the rated speed in  $10\pm2$  seconds.

(v) For electric dynamometer operation in speed mode, motoring assist may be used to offset excessive dynamometer inertia load when necessary. No negative flywheel torque shall occur during any of the three acceleration modes in paragraph (a)(2) of this section except for a maximum of 10ft-lbs. for the first 0.5 second of the mode.

(3) *Lugging mode.* (i) Immediately upon the completion of the preceding acceleration mode, the dynamometer controls shall be adjusted to permit the engine to develop maximum horsepower at rated speed. This transition period shall be 50 to 60 seconds in duration. During the last 10 seconds of this period, the average engine speed shall be maintained within 50 rpm of the rated speed, and the average observed power (corrected, if necessary, to rating conditions) shall be no less than 95 percent of the maximum horsepower developed during the preconditioning prior to the smoke cycle.

(ii) With the throttle remaining in the fully open position, the dynamometer controls shall be adjusted gradually so that the engine speed is reduced to the intermediate speed. This lugging operation shall be performed smoothly over a period of  $35\pm5$  seconds. The rate of slowing of the engine shall be linear, within 100 rpm, as specified in § 86.884-13(c).

(4) *Engine unloading.* Within five seconds of completing the preceding lugging mode, the dynamometer and engine controls shall be returned to the idle position described in paragraph (a)(1) of this section. The engine must be at free idle condition within one minute after completion of the lugging mode.

(b) The procedures described in paragraphs (a)(1) through (a)(4) of this section shall be repeated until three consecutive valid cycles have been completed. If three valid cycles have not been completed after a total of six consecutive cycles have been run, the engine shall be preconditioned by operation at maximum horsepower at rated speed for 10 minutes before the test sequence is repeated.

[48 FR 52203, Nov. 16, 1983, as amended at 49 FR 48141, Dec. 10, 1984; 52 FR 47870, Dec. 16, 1987; 62 FR 47122, Sept. 5, 1997]

**§ 86.884-8 Dynamometer and engine equipment.**

The following equipment shall be used for smoke emission testing of engines on engine dynamometers:

(a) An engine dynamometer with adequate characteristics to perform the test cycle described in § 86.884-7.

(b) An engine cooling system having sufficient capacity to maintain the engine at normal operating temperatures during conduct of the prescribed engine tests.

(c) An exhaust system with an appropriate type of smokemeter placed no more than 32 feet from the exhaust manifold(s), turbocharger outlet(s), exhaust aftertreatment device(s), or crossover junction (on Vee engines), whichever is farthest downstream. The smoke exhaust system shall present an exhaust backpressure within  $\pm0.2$  inch Hg of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. The following options may also be used:

(1) For engines with multiple exhaust outlets, join the exhaust outlets together into a single exhaust system and install the smokemeter 10 to 32 feet downstream from the junction of

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the individual exhaust outlets, or exhaust aftertreatment device(s), whichever is farthest downstream.

(2) For engines with multiple exhaust outlets, install a smokemeter in each of the exhaust pipes 10 to 32 feet downstream from each exhaust manifold, turbocharger outlet, or exhaust aftertreatment device, whichever is farthest downstream.

(3) For engines with multiple exhaust outlets, install a smokemeter on the exhaust pipe which produces the highest smoke levels 10 to 32 feet downstream from the exhaust manifold, turbocharger outlet, or exhaust aftertreatment device, whichever is farthest downstream. It may be required to make smoke measurements from other exhaust outlets if deemed appropriate by the Administrator.

(4) When utilizing an end-of-line smokemeter, the terminal two feet of the exhaust pipe used for smoke measurement shall be of a circular cross section and be free of elbows and bends. The end of the pipe shall be cut off squarely. The terminal two feet of the exhaust pipe shall have a nominal inside diameter in accordance with the engine being tested, as specified below:

Maximum rated horsepower	Exhaust pipe diameter (inches)
HP<50 .....	1.5

Maximum rated horsepower	Exhaust pipe diameter (inches)
50≤HP<100 .....	2.0
100≤HP<200 .....	3.0
200≤HP<300 .....	4.0
300≤HP<500 .....	5.0
HP≥500 .....	6.0

(5) When utilizing an in-line smokemeter, there shall be no change in the exhaust pipe diameter within 3 exhaust pipe diameters before or after the centerline of the smokemeter optics. Within 6 exhaust pipe diameters upstream of the centerline of the smokemeter optics, no change in exhaust pipe diameter may exceed a 12 degree half-angle.

(d) An engine air inlet system presenting an air inlet restriction within one inch of water of the upper limit for the engine operating condition which results in maximum air flow, as established by the engine manufacturer in his sales and service literature, for the engine being tested.

[48 FR 52203, Nov. 16, 1983, as amended at 62 FR 47122, Sept. 5, 1997; 63 FR 63967, Nov. 17, 1998; 70 FR 40437, July 13, 2005]

### § 86.884-9 Smoke measurement system.

(a) *Schematic drawing.* The Figure I84-1 is a schematic drawing of the optical system of the light extinction meter.

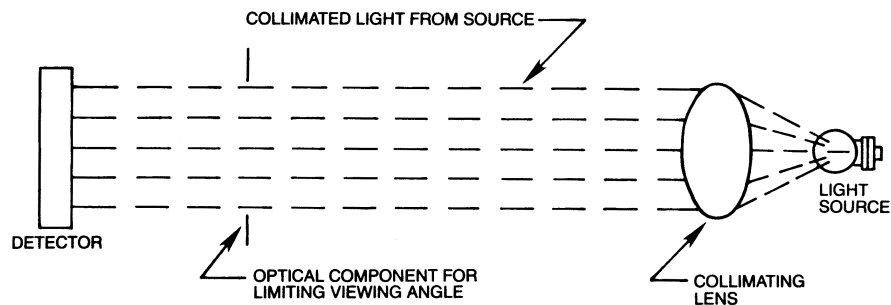


Figure I84-1 SMOKEMETER OPTICAL SYSTEM (SCHEMATIC)

(b) *Equipment.* The following equipment shall be used in the system.

(1) Adapter—the smokemeter optical unit may be mounted on a fixed or